Space Weather Technical Forecast

Issued on Saturday, 27 November 2021 at 00:41 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: The 24th November CME may arrive at Earth later on day 1 (27th) or on day 2 (28th). A further CME which left the Sun during the early hours of the 26th may give a glancing blow late on day 2 (28th) or day 3 (29th). There is a chance of a G1 Minor geomagnetic storm from days 1 to 3 (27th-29th).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low over the past 24 hours, with no significant X-ray flares. There are currently two active regions on the visible disc. AR2898 and AR2990 are both Cai/ Beta classification. 2990 developed on the 26th and has shown some fairly rapid growth. At 26/0010UTC, a faint but impulsive filament eruption was seen in H-alpha imagery as well as some SDO EUV wavelengths (e.g. AIA 304), leaving the northeastern quadrant. Imagery is inconclusive but analysis suggests a glancing blow is possible late on day 2 or day 3 (28th or 29th). The CME from the 24th may arrive late on day 1 or day 2 (26th or 27th). Confidence in the arrival time and likely impact of both these CMEs remains low.
No other events spawning potentially Earth-directed CMEs were identified in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1, fell from 400 km/s to settle about 350 km/s. The solar wind density rose to around 16 ppcc before easing back to average values between 5 and 10 ppcc. The IMF peaked at just above 6 nT, with a north-south range between -4 nT and +6 nT, mostly aligned with Earth's magnetic field from 26/0800 UTC. The phi angle remained predominantly negative. The net result of the above solar wind measures was Quiet Kp (0-2) throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels.
The high energy electron flux (greater than 2 MeV) was reached High levels between 26/1310 UTC and 26/1955 UTC, reaching a peak value of 2340 pfu at 26/1605 UTC. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), with a rising trend, reaching 6.15e7 integrated pfu at 27/0000 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low or Very Low, with a daily 40% Chance of C-class flares.

Solar Wind / Geomagnetic Activity: The 26/0010 UTC filament eruption in the northeast may give glancing blow late on day 2 or on day 3 (27th- 28th). Also, an earlier CME from a filament eruption leaving the Sun 24/1300 UTC may reach Earth late day 1 (27th), or on day 2 (28th). There is considered to be a Chance of a G1 Minor Geomagnetic storm from these events, otherwise geomagnetic activity is likely to be Quiet to Unsettled, perhaps with the odd Active interval. Confidence in the arrival time and likely impact from these CMEs is low. There may also be a weak connection with negative Coronal Hole 22, likely impacts from this are similar or lower than those from the CMEs.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels. The high energy electron flux (greater than 2 MeV) should now ease back due to lack of further significant enhancements in the period, perhaps showing a late uptick from any incident CME from days 1-3 (27th-29th).

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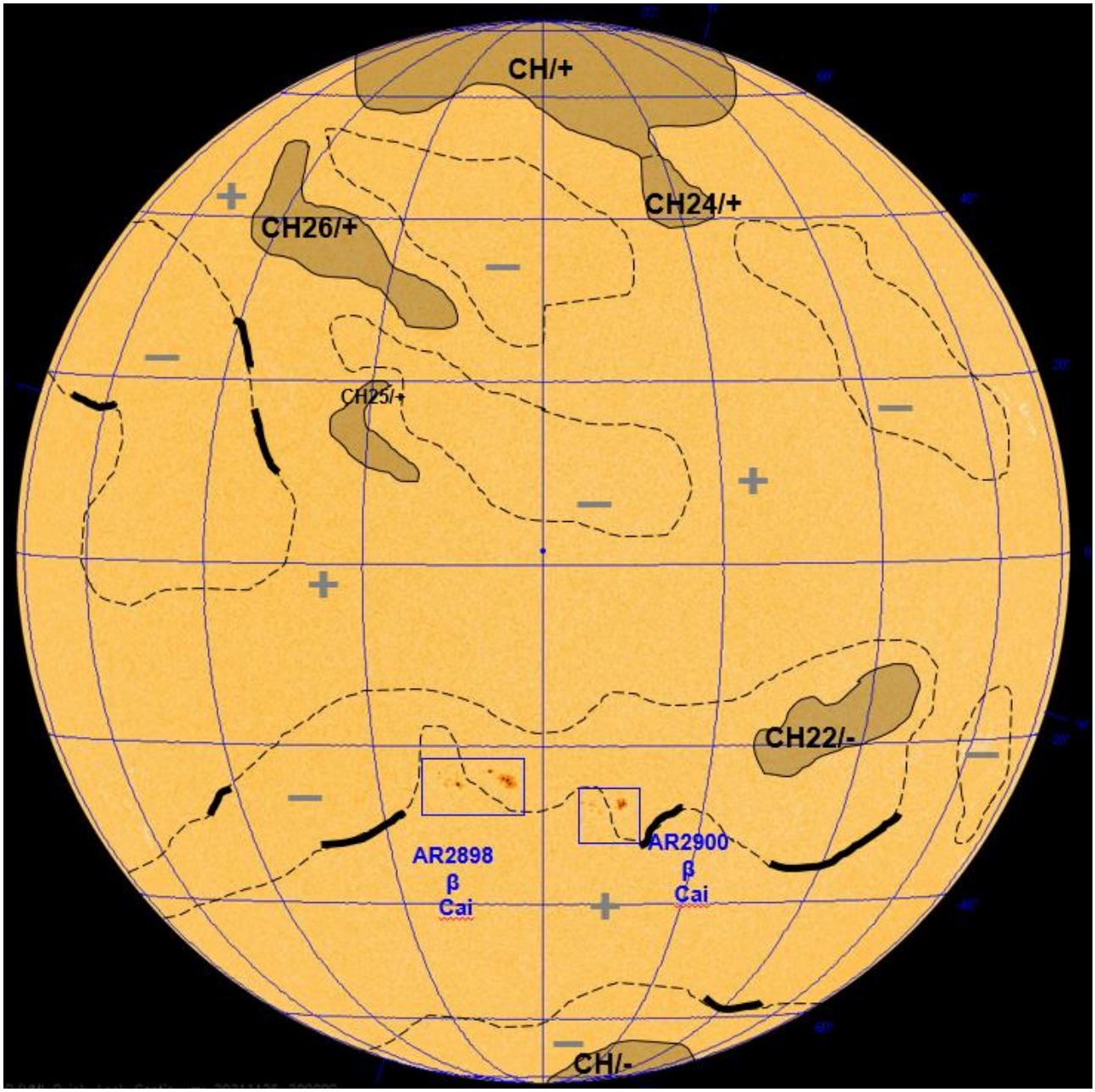
Figure 1. Solar Analysis Valid 26/2000UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The 26/0010UTC filament eruption in the northeast may give a glancing blow late on day 2 or on day 3 (28th - 29th). Also, an earlier CME from a filament eruption leaving the Sun 24/1300 UTC may reach Earth late day 1 (27th), or early day 2 (28th). There is considered to be a Chance of a G1 Minor Geomagnetic storm from either of these events, though confidence is low both regarding likely arrival time and potential impact. The trend in recent MOSWOC Enlil runs has been to reduce the peak solar wind density experienced by Earth from this event, implying a weaker onset, although the reasons for this are not clear.

Quiet to Unsettled geomagnetic activity is otherwise expected, although there is a Chance of some Active periods should CH22/- become geoeffective during days 1 and/or 2 (27th-28th), with the timing/presence of this aspect low confidence, even if the expected magnitude of effects is more certain (in being small), there is now increased confidence in the northern crown extensions not properly manifesting at Earth, despite their probable appearance in STEREO A in recent days.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	30	30	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
24/2058UTC	Partial Halo	Filament eruption	SE quadrant	500km/s	27/2300UTC	Most of the CME will be behind and below Earth.
26/0458UTC	Partial Halo	Filament eruption	NE quadrant	899km/s	28/2300UTC	Glancing blow at best with most of the CME above Earth.

Figure 2: MOSWOC Enlil shows the two CMEs referred to above.

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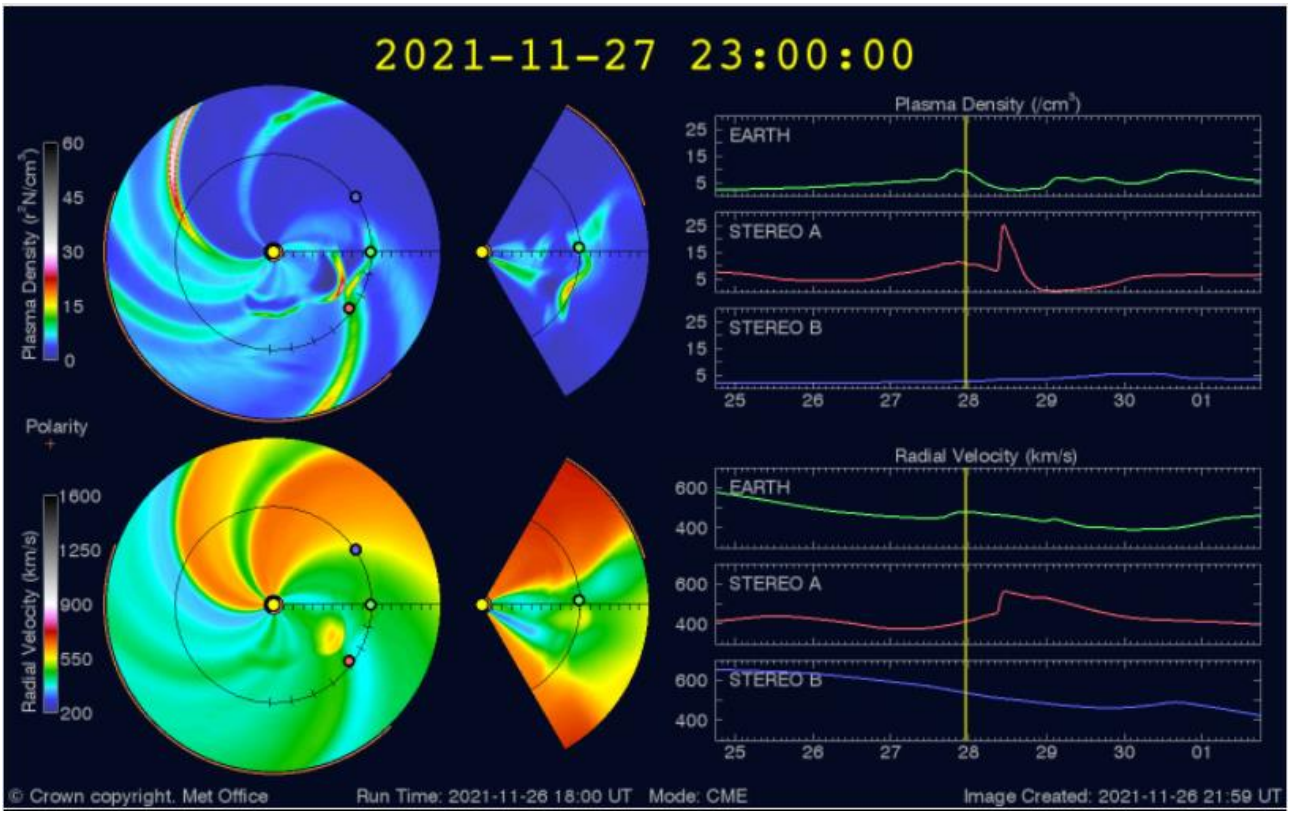

Radio Blackouts - X-Ray Flares:

There are now two sunspot regions on the visible disc, both Cai/beta classification. AR2900 developed on the 26th and has shown significant growth.

The eastern solar horizon may reveal the returning Carrington location for Ex-2893 shortly, and perhaps a possible new region later in the UTC weekend showing as bright flux to the east of this. Judgement as to any increase in flare risk is withheld for now until these show on the Earth-facing side, and the risk of significant flares is therefore very low at present, with the caveat of needing to monitor AR2898 and AR2900's growth.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	2	2	2	2
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):

In the absence of any significant flare activity, the high energy proton flux (greater than 10 MeV) is forecast to remain at background levels, with no solar radiation storms anticipated.

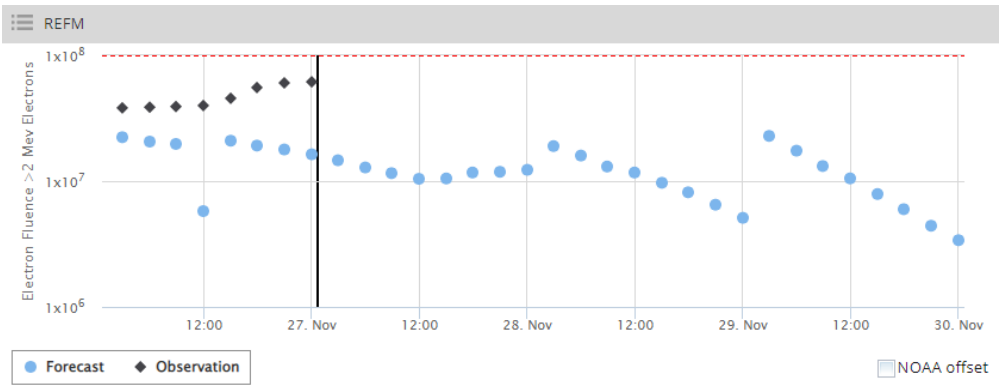
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

Integrated fluence levels have increased over the past 12 hours however mechanisms for increasing high energy electron flux further are now expected to reduce, with Earth having finally exited the high speed stream from coronal hole 20. As stated, any influence from succeeding coronal hole 22 is expected to be minor if present, and unlikely to prove capable to generate Active 24-hour integrated fluence. The biggest uncertainty in the period is therefore any response to the 24 or 26 November CMEs arrival from late day 1 (27th) through to day 3 (29th) - with these increasing uncertainty in electron levels into the next working week. Due to this uncertainty there remains a slight chance that the 1e8 Active integrated fluence level will be breached through the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	10	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: Shows the steady rise in observed fluence values forecast to remain below Active levels.



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